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ABSTRACT

Childhood injury continues to be a major public health crisis in the United States, with a large percentage of injuries being preventable and controllable. This chapter provides information related to understanding child and youth injury. Studies have shown that injuries affect identifiable high-risk groups. Such host factors that put children at higher risk include: (1) gender differences, with males at a higher risk than females; (2) lower socioeconomic status; and (3) race. Agent and environmental factors are also explored. Developmental differences are outlined that influence the incidence of injury and its prevention. These studies find the leading causes of death for the following age groups are as follows: (1) younger than 1 year--homicide; (2) 1 to 4 years--fire and burns; (3) 5 to 9 years--motor vehicle passenger injuries; and (4) 10 to 14 years--motor vehicle passenger injury. The chapter describes injury control orientations, including: (1) social competence; (2) social learning theory; and (3) health belief model. Prevention strategies are also described: (1) environmental and passive methods; (2) legislative methods; and (3) educational methods. Two examples of injury prevention classroom programs are provided: an integrated car safety program and the Safety Fair program. The article concludes with recommendations for injury prevention practice and policy development. (Contains 74 references.) (SD)

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• *CHAPTER 9* •

# Prevention and Control of Injuries

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Several years ago, when C. Everett Koop was U.S. surgeon general, he made the now widely quoted remark that "if a disease were killing our children in the proportions that accidents are, people would be outraged and demand that the killer be stopped." Childhood injury continues to be a major public health crisis in the United States, as injuries have replaced infectious diseases as the leading cause of childhood death (Baker & Waller, 1989). Although the pain and suffering associated with these injuries are distressing, it is fortunate that many of their causes are being identified and, consequently, that a number of effective and promising interventions have been developed to prevent and control their occurrence.

The terms *injury* and *accident* are often used interchangeably in both the lay and professional literature, but the term *injury* is preferred because *accident* implies that the trauma results from a twist of fate, is not within human control, and is therefore unavoidable. A large percentage of childhood injuries indeed *are* preventable and controllable, as illustrated throughout this chapter. Furthermore, the assumption is that children who are socially competent are less likely to engage in behaviors that lead to injury (Consortium on the School-Based Promotion of Social Competence [Consortium], 1994). Psychologists, social workers, counselors, physicians, teachers, nurses, and other human service providers are

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in positions to help parents, children, and communities decrease the number and the severity of injuries substantially, thereby cutting the enormous associated costs to individuals and society. Unless efforts to prevent the occurrence of injuries are undertaken, however, significant changes in injury morbidity and mortality rates are unlikely.

In this chapter, we first provide information related to understanding child and youth injury. Next, we outline developmental differences that influence the incidence of injury and its prevention. The following section describes injury control orientations and prevention strategies. We conclude with recommendations for practice and policy development. Our primary focus is on unintentional injury, although we include some discussion of intentional injury.

## Understanding Child and Youth Injury: A Public Health Perspective

In this section, we review a number of issues that can help in understanding injury among young people. Application of this information to prevention strategies is included.

Injury among children and youth is a major public health issue because of the magnitude of the number of injuries, the potential years of life lost because of injury, and the associated costs to society. Injury is the leading cause of death during childhood, killing more children each year than all other diseases combined. Recent reports from the Centers for Disease Control and Prevention (CDC, 1995) indicate that 7,200 unintentional injury deaths occurred among children under the age of 15 years in 1991 and that an additional 1,600 deaths resulted from intentional injuries. To illustrate the extent of the problem, consider that in 1990, a national crusade was launched to eliminate measles in response to 40 deaths that year among unvaccinated children. In contrast, 24 children in the United States under the age of 15 years died *every day* that year from injury.

Approximately 13 million children are injured severely enough each year to require medical attention. About 1.4 million children are treated and released from emergency departments, but 360,000 children require hospitalization. Moreover, it is estimated that 50,000 children each year are permanently disabled by an injury

(CDC, 1995). Because of the large numbers of young victims, injuries claim more potential years of life each year than heart disease, cancer, and stroke combined (Rice et al., 1989). Almost 5.3 million potential years of life are lost annually to injuries, an average of 36 years per fatal injury (Robertson, 1992).

The financial, psychological, and social costs resulting from pediatric injury are great. The dollar costs associated with each injury death are higher than for any other disease, averaging about four times more than for cancer and more than six times that of cardiovascular disease. Annual medical costs and projected lost earnings associated with each death are estimated at $335,000 per injury death, $88,000 per cancer death, and $51,000 per cardiovascular disease death (Rice et al., 1989). Medical costs alone are estimated at $200 billion, an impressive figure in an era focused on health economics (Rice et al., 1989; Rosenberg, 1992). Yet the amount of federal spending for injury prevention and treatment is less than 17% of the total spent in cardiovascular research and 11% of the cancer research budget (Rice et al., 1989).

Psychological trauma also results from both unintentional and intentional injuries and can develop into short-term conditions such as acute stress disorders or more severe ones such as posttraumatic stress disorders. Social costs include the psychological and economic toll on the family, needless loss of promising and productive young people, and diversion of resources from beneficial educational and health programs to treatment efforts for pediatric injuries.

The public health model suggests that the epidemic of pediatric injury can be controlled through identification of risk factors, development of appropriate interventions, and evaluation of these efforts. The U.S. pediatric injury mortality rate has decreased steadily throughout this century with marked declines in the 1970s and 1980s. Among children under 20 years of age, injury death rates dropped about 27% between 1978 and 1991, from 40.22 per 100,000 to 29.58 per 100,000 (Rivara & Grossman, 1996).

Although the pediatric unintentional injury rate decreased by 38.9%, the death rate resulting from intentional injury increased by 47.1%. The homicide rate for persons of all ages increased from 1985 to 1991 and has declined since 1992 (CDC, Division of Violence Prevention, 1996). The January 28, 1994, *Morbidity and Mortality Weekly Report* ("Death Resulting From Firearms")

projected that if current trends continue, the death rate from firearms will surpass that of motor vehicle crashes by the year 2003.

The importance of pediatric injury as a public health issue is emphasized further by the number of related goals included in *Healthy People 2000* (U.S. Department of Health and Human Services, Public Health Service [DHHS], 1991, 1995), which describes national health promotion and disease prevention objectives and opportunities. As shown in Table 9.1, the prevention of behaviors that can be related to intentional and unintentional injury is the focus of a substantial number of these objectives.

## Risk Factors and Protective Mechanisms

Prevention and competence-enhancement approaches can help young people and their adult caregivers focus on (a) increasing skills that encourage the development of positive, health-enhancing behaviors such as defensive driving and anger control skills, (b) eliminating or reducing health-compromising actions such as driving after drinking and diving into shallow water, and (c) altering environments so they are more supportive of these activities. Particularly important to this discussion is that many behaviors associated with injuries are learned (often early in life) and, therefore, are amenable to change or modification. In other words, numerous factors that lead to injury are under the control of young people and their caregivers. In contrast to some of the topics in this volume, however, injury prevention efforts cannot solely be directed toward children and youth but also must involve adult caregivers because these individuals are important mediators of children's environments.

Risk factors place children in harm's way for injury and are associated with an increased likelihood of being injured. Benson (1993) surveyed 47,000 youth in grades 7 through 12 and identified a number of common risk indicators associated with negative health outcomes. Included were risks related to injury, such as having five or more drinks in a row during the last two weeks, attempting suicide, taking part in a fight, driving after drinking, and not using seat belts all or most of the time.

In contrast, protective mechanisms serve to buffer or protect an individual from injury. In Benson's (1993) study, he also found common protective factors associated with positive health out-

**Table 9.1.** Examples of *Healthy People 2000* Injury Risk Reduction Objectives for Children and Youth

| | |
|---|---|
| **Injury Related to Mental Health** | |
| 4.10 | Increase the percentage of high school seniors who associate risk of physical or psychological harm with heavy use of alcohol to 70%. |
| 6.1a & 7.2a | Reduce suicides among youth aged 15 to 19 to no more than 8.2 per 100,000 people. |
| 6.2 & 7.2b | Reduce by 15% the incidence of injurious suicide attempts among adolescents aged 14 to 17. |
| **Unintentional Injury** | |
| 9.12a | Increase the use of occupant protection systems such as safety belts, inflatable safety restraints, and child safety seats to at least 95% of children aged 4 and younger who are motor vehicle occupants. |
| 9.3b | Reduce deaths among youth aged 15 to 24 caused by motor vehicle crashes to no more than 33 per 100,000 people. |
| 9.5 | Reduce drowning deaths to no more than 1.3 per 100,000 people. |
| **Violent and Abusive Behavior** | |
| 7.1 | Reduce homicides to no more than 7.2 per 100,000 people. |
| 7.3 | Reduce weapon-related violent deaths to no more than 12.6 per 100,000 people from major causes. |
| 7.4 | Reduce to less than 25.2 per 1,000 children the rising incidence of maltreatment of children younger than age 18. |
| 7.7a | Reduce rape and attempted rape of women aged 12 to 34 to no more than 225 per 100,000. |
| 7.9 | Reduce by 20% the incidence of physical fighting among adolescents aged 14 to 17. |
| 7.10 | Reduce by 20% the incidence of weapon carrying by adolescents aged 14 to 17. |

SOURCE: U.S. Department of Health and Human Services, Public Health Service (1995).

comes. Those related to injuries included parental monitoring of behavior, displaying assertiveness skills, and possession of friendship-making, decision making, and planning skills. Such skills may decrease children's and youth's susceptibility to injury. Environmental factors also play a role in risk reduction and protection.

## Epidemiology of Injury

As noted earlier, injuries are not random events but result from predictable behaviors and disproportionately affect identifiable



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high-risk groups. The traditional model of host, agent, and environmental risk factors for disease is a useful construct in understanding the epidemiology of injury (Lilienfeld & Lilienfeld, 1980).

*Host Factors.* The host is the individual (e.g., child) who sustains the injury. Host factors are intrinsic characteristics that affect exposure, susceptibility, or response to an injury-producing agent or event. The developmental stage of the person is a key variable in determining exposure and response. Although young people are exposed to injury as motor vehicle passengers throughout all developmental stages, they are injured and killed at much higher rates when they start to ride with other teens or become drivers themselves. Mechanisms of injury vary by age, making assessment of developmental stage a key factor in developing interventions. Developmental influences affecting injury mechanisms and rates are discussed in more detail in a later section.

Injury patterns show distinct gender differences, with males at a much higher risk for most types of injury than females at all ages. Further, as age increases, so does the excess risk for males. During adolescence, males are four times more likely to die from an injury than are females (Rivara, 1992).

Lower socioeconomic status also has been associated with higher pediatric injury rates (Nersesian, Petit, Shaper, Lemieux, & Naor, 1985). Substandard housing with inadequate smoke detectors and poorly accessible evacuation routes, more playtime spent in or near streets, high traffic volume, and older cars with missing or inoperable safety belts increase exposure to many mechanisms of injury. In addition, living in low-income areas and having minority status place an individual at twice the risk of victimization (Singer, 1987).

Race is another risk factor for injury. Non-White children under 15 years of age die of intentional injuries almost twice as often as White children (CDC, 1995). Among African Americans, homicide is now the leading cause of death for males aged 15 to 34 (Rosenberg & Mercy, 1991), with male teenagers in this group five to six times more likely to die of homicide than their White peers, and female teens two to three times more likely than their White peers (Doren, Bullis, & Benz, 1996). Pediatric injury deaths are almost three times higher among Native American infants and preschool children than among the general population the same age (Rosenberg & Mercy, 1991). Race is related to exposure not only

to injury-causing factors but also to physiologic response. The same amount of mechanical energy that results in only a soft tissue injury in an African American child may result in a fracture in a White child of similar age, height, and weight because of racial differences in bone mineral density (Li, Specker, Ho, & Tsang, 1989; Rupich, Specker, Lieuw-A-Ta, & Ho, 1996).

*Agent Factors.* Energy is the agent of injury. Exposure to mechanical, thermal, chemical, electrical, or radiation energy in doses that exceed the body's tolerance results in injury. For instance, being thrown against a car windshield when riding without a seat belt can lead to injury when the individual's tolerance for absorbing that force is exceeded. Injury can also result from events that deprive body tissues of oxygen, which interferes with the body's ability to produce energy, as in asphyxiation and drowning (Robertson, 1992). The amount of energy that is beyond body tissue tolerance levels determines the severity of the injury.

*Environmental Factors.* Pediatric injury incidence varies within the United States by geographic location. Warmer areas with higher numbers of swimming pools per capita have higher drowning rates among toddlers and preschoolers (American Academy of Pediatrics [AAP] Committee on Injury and Poison Prevention, 1993; Mann, Weller, & Rauchschwalbe, 1992; Wintemute, 1992), whereas colder regions have higher rates of skiing and snowmobile injuries. More serious falls occur in urban areas with high-rise residential buildings, more farm machinery-related injuries occur in rural areas, and interpersonal violence rates are higher in more densely populated, crowded areas.

Contingencies in the environment can also increase the probability of injuries. For example, traffic light patterns in busy, urban intersections can be timed either to increase the risk of a child pedestrian being injured by leading to more jaywalking (Jason & Liotta, 1982) or to reduce the risk of injury by influencing driver traffic rule compliance behavior (Jason, Neal, & Marinakis, 1985).

The interactions of host, agent, and environmental factors result in differential injury rates. Accordingly, at-risk groups can be identified and targeted for further study to determine why injury rates are higher and which interventions may be most likely to be

effective. As discussed in the next section, developmental factors are important considerations, especially for pediatric injury deaths.

## Developmental Factors Influencing Injury Incidence and Prevention

Examination of developmental factors associated with injury death can be a helpful element in designing effective preventive strategies. Our focus is on injury deaths, but in a comprehensive prevention program it also is important to address nonfatal injuries.

### Infants (Younger Than 12 Months)

As shown in Table 9.2, homicide is the leading cause of both intentional and unintentional injury deaths in this age group. During 1991, unintentional injuries resulted in 961 deaths among infants under 1 year of age (CDC, 1995), with asphyxiation/suffocation being the most frequent mechanism of unintentional injury deaths and accounting for about 40% of all unintentional injury deaths in this age group. Most of these deaths result from choking on food or small items.

The next most frequent mechanisms of unintentional injury deaths during infancy are car crashes, fires and burns, and drowning. In 1993, 153 infants died in car crashes (AAP, 1994). Infants require adult intervention to restrain them properly in an appropriate child safety seat (CSS), and a properly used CSS reduces the risk of infant death in a crash by 69% (CDC, 1991). Although rate of use for CSS is approximately 76% among infants (Johnston, Rivara, & Soderberg, 1994), estimates of improper use of a CSS range as high as 82% (Bull, Stroup, & Gerhart, 1988). Studies of adult knowledge about proper use of a CSS have demonstrated a lack of accurate information, which can result in improper use of restraints (Ruffin & Kantor, 1992). The effectiveness of the CSS results from its ability to prevent ejection from the vehicle and to dissipate the mechanical energy generated in a crash through the seat components rather than to the infant's body. Improper installation of the seat in the vehicle or failure to appropriately harness the child into the seat impairs the ability of the CSS to adequately dissipate the energy forces.

**Table 9.2** Leading Causes of Injury Death by Age

| *Less Than 1 Year* | *1 to 4 Years* | *5 to 9 Years* | *10 to 14 Years* |
|---|---|---|---|
| Homicide | Fire/burns | Motor vehicle passenger | Motor vehicle passenger |
| Asphyxiation/ suffocation | Drowning | Pedestrian | Homicide |
| Motor vehicle passenger | Homicide | Fire/burns | Suicide |
| Fire/burns | Pedestrian | Drowning | Suicide |
| Drowning | Motor vehicle passenger | Homicide | Drowning |

SOURCE: CDC (1995).

Drowning in infancy differs from drowning in school-age children. Infants are more likely to drown in a bathtub (it can occur with only a few inches of water) or to fall head first into a bucket (AAP, 1993; Fiser, 1993; Mann et al., 1992). Because of their proportionately larger heads and higher centers of gravity, they are unable to extract themselves from the containers.

### Toddlers and Preschoolers (1 to 4 Years)

Fires and burns are the leading mechanism of injury death among children 1 to 4 years of age. Drowning, homicide, pedestrian injuries, and car crashes are the next most frequent mechanisms of fatal injuries (see Table 9.2).

The unchecked curiosity that is characteristic of toddlers often leads them to experimentation and exploration. Imitation of adult behaviors such as manipulation of cigarette lighters and matches results in tragic numbers of fatal fires each year, with 85% of the deaths resulting from burns and fires occurring in house fires (Rivara, 1994).

Many drownings in this age group also result from spontaneous, impulsive behavior. Most drownings involving toddlers and preschoolers occur in bathtubs or residential swimming pools, usually at the child's own home or that of a relative or friend (Fiser, 1993; Wintemute, 1990). In one California study, 89% of all drownings among 2- and 3-year olds occurred in neighborhood swimming



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pools (Wintemute, 1992). For most preschool drowning incidents, the history of the incident indicates that the supervising adult's attention was diverted from the child momentarily, such as by a telephone call or stove timer. Further, the majority (70%) of children in this age group who drown are wearing street clothes, indicating that the caretaker did not anticipate that the child would be playing in the pool (Present, 1987).

Pedestrian injuries are most likely to occur near a driveway or sidewalk. Toddlers playing or riding low tricycles in a driveway are at risk for having a car back over them, particularly if the family vehicle is a van or sports utility vehicle in which visibility for low objects may be difficult (Winn, Agran, & Castillo, 1991).

Although the majority of infants are restrained in a CSS, use rates for toddlers and preschoolers drop precipitously. Restraint use for preschoolers has been observed to range between 6.3% and 43% (Arneson & Triplett, 1990; Chang, Dillman, Leonard, & English, 1985; Morrow, 1989; Partyke, 1983; Roberts, 1986; Stuy, Green, & Doll, 1993). As a result, motor vehicle occupant injuries among children under 4 have been targeted as a national health priority by *Healthy People 2000* (DHHS, 1995), with a goal of 95% safety restraint use (see Table 9.1). Also important is that adult lap belts are estimated to be about 30% effective in preventing fatalities among 2- to 5-year-olds, primarily through preventing ejection from the vehicle or secondary collisions with the interior of the vehicle (Agran, Dunkle, & Winn, 1987; Hendey & Votey, 1994; Osberg & DiScala, 1992; Tso, Beaver, & Haller, 1993). There is general agreement that existing adult restraint systems are not adequate for toddlers and preschoolers. Therefore, the AAP (1995) recommends the use of a CSS for children up to 40 pounds and a booster seat for children from 40 to 60 pounds. Further, there is emerging concern about the safety of air bags when infants and toddlers ride in the front seat facing forward.

### School-Age Children (5 to 9 Years)

Motor vehicle injuries are the leading cause of injury-related deaths in this age group. They are followed by pedestrian injuries, fires and burns, drowning, and homicides (see Table 9.2). Pedestrian injuries are more likely to result from midblock dart-outs (Agran, Winn, & Anderson, 1994; Malek, Guyer, & Lescohier, 1990; Winn

et al., 1991). The impulsive behavioral characteristics of school-age children often lead to quick movements without an adequate search for oncoming traffic, and stopping in or returning to the roadway to retrieve a dropped or a missed item such as a ball.

Drowning deaths in this age group are four times higher among children with epilepsy or other seizure disorders (Diekma, Quan, & Holt, 1993). Such children are especially vulnerable for drowning in bathtubs and swimming pools.

### Pre- and Early Teens (10 to 14 Years)

Motor vehicle occupant injuries continue to be the most common mechanism of injury deaths for 10- to 14-year-olds as they were for the previous group. Next are homicide, suicide, pedestrian injuries, and drowning. Intentional injuries are also a significant problem for these youth. If violence among youth continues to become more lethal (e.g., involving firearms), our concerns likewise will grow.

Drowning in this age group demonstrates a different pattern from that observed in younger children. Drowning is more likely to occur in natural bodies of water such as lakes and rivers (Orlowski, 1987), with alcohol increasingly identified as a contributing factor in a high percentage of these incidents (Wintemute, Teret, Kraus, & Wright, 1990).

## Injury Control Orientations and Prevention Strategies

A variety of intervention methods have been applied to the prevention of injuries. In recent years, a multifaceted approach involving several different strategies has been the preferred approach when sufficient resources are available. A brief description of several perspectives and strategies is included here.

### Conceptual Framework

*Social Competence.* As noted earlier and as might be anticipated on the basis of the contents of this volume, we assume that children

and youth who are socially competent will be less likely to experience physical injury, particularly of a serious nature. Such individuals possess a number of characteristics that enable them to avoid engaging in behaviors that may lead to injury, as they gradually develop the cognitive, affective, and behavioral skills to engage in health-enhancing and health-protective behaviors (Consortium, 1994). Social competence for young children, however, who rely primarily on adult caregivers to ensure their safety, is much different from that for older children and adolescents who can take more responsibility for their own well-being.

Social competence also is related to factors beyond the individual. We believe that socially competent children tend to have more socially competent role models. These models help ensure that the children's environment is healthy and safe (e.g., provide adequate supervision and work toward adoption of laws conducive to health) and engage in behaviors themselves that reflect an awareness of safety issues (e.g., use seat belts and do not drink and drive), thereby further decreasing the number or severity of children's injuries.

There are several reasons why socially competent young people may be injured less often. They tend to possess skills that may serve as protective mechanisms against injury. For instance, they can generate effective solutions to problems, delay immediate gratification for longer-term rewards, identify the consequences of their actions, and resist negative peer pressures—skills that can be applied to help them avoid risk taking and injury. A junior high student may be able to apply his or her social problem-solving skills when confronted by a class bully, especially because many of these incidents involve increasing amounts of violence. Instead of responding with physical aggression or overly emotional responses that may provoke the bullying, the child may select a low-key approach. That is, he or she can avoid high-risk places when possible, use humor to defuse the situation, or respond assertively ("I don't like it when you take my backpack") and walk away. Or the child may recognize that the bully wants to be friends but does not have the social skills to initiate a relationship and thus respond accordingly. In contrast, those lower in personal/social skills have been found to be more likely to experience victimization (e.g., be beaten up) some time in their school career than those with higher skills in this area (Doren et al., 1996).

*Social Learning Theory.* Social learning theory (SLT; Bandura, 1977b) has been widely applied to understanding human behavior within a social context. It can be helpful in understanding childhood injury, and programs based on its principles have been shown to be successful (Pless & Arsenault, 1987). SLT is based on the notion that an individual's behavior can be understood only by examining interactions among the individual, other persons in the environment, and key aspects of the environment itself. Therefore, it is essential to consider the person from within an environmental context.

The model predicts that new behaviors are learned through a combination of (a) observations of competent models, (b) direct experiences in the performance of the desired behaviors (e.g., obtained through role playing and behavioral rehearsal) with corrective feedback, and (c) positive reinforcement for accurate performance. Modeling especially is seen as a powerful means of influencing learning or behavior change principally through its informative function; the modeled activities serve as guides for appropriate performance. Bandura (1977b) suggested that to learn from behavioral modeling, children must attend to what the model is doing, process and remember what the model did, practice what the model did and receive corrective feedback, and begin to use what they have learned at appropriate times.

Another key concept in SLT is reciprocal determinism, which suggests that individuals are influenced by their environment and, in turn, have an influence on it (Bandura, 1977a, 1982). SLT also recognizes the importance of intrapersonal variables such as thoughts, perceptions, and attributions. Further, individuals' behavioral histories affect their personal views of themselves, which reciprocally mediate how they behave. Thus, behavior results from interactive cycles of intrapersonal factors, behavioral actions, and reactions from others in their environment.

To further explain SLT, we present an example of its application to CSS use. SLT predicts that children and their parents learn to use safety seats through a combination of (a) observing their correct use by other children and adults, (b) direct experiences of the children in using the seats and of parents in placing their children in safety seats (e.g., which may be obtained through role playing and behavioral rehearsal) with corrective feedback, and (c) positive reinforcement for correct use and performance.

Reciprocal determinism also implies that health behaviors such as CSS use can be changed by altering any of the three elements, that is, intrapersonal factors, interactions with others, or the environmental context. Changing the environmental consequences for an action such as correctly using a CSS changes the children's behaviors and perceptions of themselves; similarly, changing the children's behaviors with respect to using safety seats changes the reactions of parents to the children. Correct modeling of CSS use by parents and other children likewise would be important.

*Health Belief Model.* The health belief model provides a framework for explaining why people do and do not practice health-related behaviors (Becker, 1974, 1979; Becker & Maiman, 1975). It suggests that people will take action when their behavior leads to an outcome that is valued and when they have an expectancy that the outcome can be achieved. The model has been extensively researched and applied to a number of preventive health behaviors, including compliance to medical regimes.

The health belief model is based on the assumption that health behaviors are more or less rationally determined by individuals' assessment of a potential health threat. From this perspective, people's readiness to engage in a health action is related primarily to perceptions of susceptibility, and perceptions of severity or seriousness of the injury. The likelihood of taking health actions is also determined by individuals' perceptions of the efficacy of their behavior. In other words, people proceed through a cost-benefit analysis associated with the preventive action. Finally, persons' sense of self-efficacy (Bandura, 1977a, 1982), that is, their belief that they can successfully accomplish the action required to achieve the goal, is an additional contributor to decisions concerning health behaviors (Rosenstock, Strecher, & Becker, 1988).

Several other mediating factors are related to health behaviors. Cues to action (e.g., being reminded or alerted about a potential problem) may increase preventive actions. Demographic variables (e.g., gender, age, race, and ethnicity), psychosocial factors (e.g., personality traits, social class, and social pressure), and structural variables (e.g., knowledge about or past experience with the health problem) also help determine the likelihood of taking preventive action.

In the example of car safety seats presented earlier, the health belief model predicts that the decision to use safety seats is determined by parents' perceptions of their children's vulnerability to injury and their perceptions of how severe these injuries might be. In addition, the decision may be influenced by cues to use safety seats, barriers such as the price of purchasing safety seats, the children's reaction to being placed in safety seats, and the ease with which the seats operate. Demographic, structural, and psychosocial factors may also be associated with seat use. In sum, parents who feel their children's health is threatened may use car safety seats, whereas those who do not have this belief would not use them.

### Prevention Strategies

*Environmental and Passive Methods.* The most effective interventions tend to be those that require little behavioral change by the targeted group because they work automatically and require little effort on behalf of the target (Rivara, 1992). For instance, electric eyes that automatically stop garage doors when an object is in the way, fire retardant infant clothes, and reduced injury factor (soft) baseballs necessitate little effort after being installed or purchased, and therefore are in place in the event that a potential injury-producing event occurs. On the other hand, looking in all directions before crossing the street, wearing roller blade helmets and pads, and putting on a life jacket require an action each time a young person engages in the relevant activity, and as a result, they are not used with the same frequency as the other examples. Thus, intervention effectiveness is related to the amount or frequency of the behavioral change required (Cataldo et al., 1983), with the likelihood of use decreasing as more effort is needed.

*Legislative Methods.* A number of mandated or legislated methods have been adopted to prevent injury, and it is possible to use behavioral methods to influence legislation. For example, in recent years, every state has mandated some form of child passenger restraint system. As indicated earlier, thousands of children are injured or killed as a result of motor vehicle crashes each year. The majority of these injuries and fatalities could have been prevented if appropriate child restraints were used. Accordingly, legislation

mandating use of such restraints represents a viable strategy for dealing with this pressing social problem. A variety of strategies were used by states to enact relevant legislation, and the following example (which also contains an educational component) is included because of its potential applicability to legislation for other interventions such as use of bicycle safety helmets.

Jason and Rose (1984) evaluated the effects of sending technical information regarding the number of children killed or injured in car crashes and the use of car safety restraints to Illinois legislators just prior to a vote on a child passenger restraint bill. They also provided legislators with data concerning the state's share of medical care costs following debilitating traffic injuries and with the results of a citizen survey that supported passage of the bill. Jason and Rose found that 79% of the senators receiving the information voted for passage of the bill, whereas only 53% of the senators not receiving the letter voted in favor of it.

Surveillance data indicated an increase in child restraint use, particularly for infants, just before enactment of the legislation; this was likely a result of the positive publicity that the media gave to the proposed legislation. Notably, with passage of the law, still higher rates in use were observed. Four observations taken before and after the law was passed indicated that infant use of appropriate restraints increased from 49% to 74%, whereas for children aged 1 to 4 years, use increased from 13% to 42%. Child deaths due to car crashes also decreased 53% during the 2 years before and 2 years after enactment of the law (Fawcett, Seekins, & Jason, 1987).

*Educational Methods.* These approaches motivate change by providing information about safety issues (e.g., risk of approaching cars with unknown drivers in them or of eating Halloween candy without having an adult inspect it), and often involve the use of prompts and reinforcement (e.g., school awards for best decorated bicycle helmets and free soft drinks from drive-through restaurants for patrons using seat belts). As noted earlier, one reason people engage in various health behaviors is related to their perceptions of vulnerability to injury and their views of how severe these injuries might be, along with the use of cues.

Although educational methods, particularly one-shot efforts, may produce some short-term benefits, change usually is not observed through long periods (Geddis & Pettengel, 1982). Conse-

quently, to produce the best outcomes, educational efforts must be combined with other continuing approaches as discussed next, to increase the likelihood that sustained change will result (e.g., Pless & Arsenault, 1987; Rivara, 1996; Zins, Garcia, Tuchfarber, Clark, & Laurence, 1994).

### Comprehensive Injury Prevention

*Program Development.* As the preceding discussion suggests, the use of a variety of intervention methods is clearly needed in a comprehensive injury prevention program. Environmental, educational, or mandated methods alone cannot solve all the problems but in combination can make a noticeable difference because most injury-producing events are too complex for simple, one-dimensional interventions (Zins et al., 1994). Furthermore, the better defined the target population and the mechanism of the injury, the more likely it is that the prevention program can be directed toward factors that will result in desirable behavioral changes and, ultimately, a reduction in injury rates. It usually is not cost-effective to target individual children because of resource constraints and the lack of success in identifying "high-risk" children, but at the same time, it may be inefficient to focus on the entire population when the incidence rate or the severity of a certain injury is low. Demographics such as geographic location may also influence the direction of efforts (e.g., swimming pool safety is more of a concern in Florida than in Montana). The challenge is in how to most efficiently and effectively direct the available resources, thereby having the greatest impact. Likewise, because so many potential injuries could be addressed, priorities need to be established related to the frequency and severity of a particular injury and also with regard to the known effectiveness of particular intervention strategies (Grossman & Rivara, 1992).

Another consideration has to do with intervention integrity. That is, to be maximally effective, injury prevention technology must be used as designed. It is not enough for a child to wear a bicycle safety helmet or to be placed in a child restraint system; the helmet must be worn properly (e.g., not too far back on the head or too loosely) and the restraint must be engaged appropriately (e.g., infants under 20 pounds should not face the front of the car; adult seat belts may

be less effective with children under 8 years of age). There simply are too many instances in which available technology could have prevented an injury if it had been used or if it had been applied properly. Finally, injury prevention does not belong to one element of the community or to one profession. To be most effective, prevention efforts should involve a coalition of interested community members including parents, teachers, legislators, health care professionals, behavioral scientists, and so forth, as well as children, so that their various perspectives can be considered and their commitment energies focused.

*Evaluation.* A systematic, objective way of determining the effectiveness and limitations of any intervention is needed to determine whether it should be continued, modified, or discontinued. One aspect missing from many prevention programs, however, is an evaluation component that measures the extent to which a program is attaining its immediate objectives (so adjustments can be made if needed) and what overall goals are reached and that help direct future efforts (Consortium, 1994). Further, specific plans to examine these issues should be included when a program is first being developed.

With respect to injuries, measuring changes in injury mortality and morbidity rates is important, but these cannot be the only outcomes assessed. As noted earlier, the integrity with which the preventive intervention was provided must first be examined. If the technology is not used appropriately, then it is impossible to evaluate its efficacy. Furthermore, it is important to examine differences in risk and protective behaviors that may be associated with the injury prevention program. For instance, are children (and their caregivers) engaging in high-risk behaviors such as swimming without a lifeguard; keeping the temperature of the hot water heater above 120 degrees; or crossing the street without stopping and looking left, right, and left again? Can they be observed properly using injury prevention technology such as safety boundaries at bus stops; smoke, heat, and carbon monoxide detectors; flotation devices on a boat; and athletic safety glasses? Have relevant policies and regulations been enacted such as requiring that bicycle safety helmets be worn, window guards be installed in high-rise buildings, and gun cabinets be locked? Are children knowledgeable about safety-related behaviors and the steps they can take to ensure their

own well-being? Multiple measures should be taken to evaluate the success of the program and to determine future directions.

## Examples of Injury Prevention Programs

Successful injury prevention programs for children and youth have been conducted in a variety of settings. Examples of community-based programs include ones that targeted children's bicycle helmet use (Rivara et al., 1994), falls from high-rise windows and use of window guards (Barlow, Niemirska, Gandi, & Leblanc, 1983; Spiegel & Lindaman, 1977), and overall neighborhood safety (Davidson et al., 1994).

Schools are also excellent settings for establishing injury prevention programs in cooperation with community personnel and parents because they provide access to a large number of children and youth. A further advantage is that programs in schools have the potential to affect not only students but also out-of-school siblings, parents, and teachers.

In this section, two examples of our work with injury prevention in the classroom are provided. In the first, a single safety message is integrated throughout the curriculum, whereas the second strategy employs a short-term but highly engaging activity that addresses multiple safety issues. Both approaches can be implemented by a single institution, as detailed in the following section, and both illustrate use of social learning theory and the health belief model.

### Integrated Car Safety Program

Preschool is developmentally an ideal time to teach safety skills such as use of the CSS to children. Programs designed specifically to increase use among preschoolers, however, have been generally ineffective. As might be anticipated, those with a relatively short-term educational intervention (2 to 4 weeks) have failed to demonstrate an increase in observed restraint use (Arneson & Triplett, 1990). Programs that reward parents, children, or both for buckling up produce only short-term gains; use rates quickly deteriorate to near baseline levels after the reward is removed (Geddis & Pettengel, 1982; Roberts, 1986; Roberts & Turner, 1986; Sowers-

Hoag, Thyer, & Bailey, 1987). On the other hand, there is increasing evidence that programs that employ extensive modeling, role playing, behavior rehearsal, performance feedback, clear consequences, positive reinforcement, and intermittent booster sessions can effectively produce behavioral change (Zins et al., 1994). These instructional techniques, incidentally, are commonly found in social competence promotion programs (Consortium, 1994).

The preschool car safety program developed by the Cincinnati Children's Hospital Medical Center (CHMC) is an example of a comprehensive program integrated throughout the activities of the school day (Garcia, Tuchfarber, Laurence, & Clark, 1995). Although Ohio state law mandates CSS use for children less than 4 years old or under 40 pounds, data from the hospital's trauma registry indicated that many preschoolers injured or killed in car crashes were unrestrained at the time of the crash. The preschool car safety program was developed to meet this community need by increasing the use of restraints. The safety curriculum was developed by educators and pediatric health care professionals. A curriculum manual detailing specific restraint activities and how to integrate the safety message into other areas of the general curriculum was prepared. Classroom teachers participated in developing the manual to ensure that the program was developmentally appropriate and able to be implemented in the real world of the classroom. Examples of specific activities are included in Table 9.3. The curriculum was implemented in October and continued formally through April.

Parental involvement is an important part of the success of any safety program, so relevant program information was included in newsletters sent home monthly to keep parents informed of classroom activities. Specific parent questions and concerns about proper restraint use were obtained by questionnaire and answered in the newsletters. Each school held a parent program that provided opportunities for interaction with experts regarding the selection and installation of a CSS.

Teachers received a curriculum manual and in-service training at the beginning of the school year. Additional support was provided through CHMC psychological services for teachers who identified children with fears of car crashes or injuries, and during the pilot program, car seats were available at no cost to families identified by teachers as in need.

**Table 9.3. Examples of Curriculum Activities Rated Highly by Teachers During the Preschool Car Safety Pilot Program**

| *Area* | *Example of Specific Activity* |
|---|---|
| Whole language | *Journal activity:*<br>One child per day is given a backpack containing a stuffed bear with a removable safety belt, a *Riding With Bucklebear* videotape, and a notebook. The child's "homework assignment" is to watch the video with his or her family and dictate a story about a car trip to an adult caretaker. The adult writes the child's story in the notebook. The teacher reads the child's story aloud during group time the next school day.<br>For situations in which a child cannot perform the activity at home, a teacher or aide works with the child during the school day. |
| Dramatic play | *Safety Seats:*<br>Infant, convertible, and booster seats are available in all classrooms. Children buckle their dolls into infant seats and themselves into the larger seats for pretend trips. Bags of special car toys are available for the children to use to amuse the dolls and keep them happy in their seats during long trips. The children teach the dolls and other child passengers songs to sing while in a CSS. |
| Gross motor | *Pedal Cars:*<br>Safety belts are attached to plastic pedal cars which the children ride in the muscle room or outdoor play areas. Each child is issued a "driver's license" after demonstrating how to fasten the safety belt before "starting the car" and describing safe riding behaviors (staying in a CSS, keeping hands inside the car, not throwing things in the car, etc.). |
| Fine motor | *Flannel Board Stories:*<br>Colorful felt pieces are used on flannel boards by the children to tell car safety-related stories. Felt car seat shapes can be put into the felt cars and child figures placed in the car seats. A variety of shapes, including animals and buildings, are used as scenery as the cars "drive" past. |

SOURCE: Garcia et al. (1995).

Evaluation of the program was conducted through parent surveys, and comparisons were made by direct observations of restraint use in participating schools and in similar schools without the car safety program. During the program, restraint use increased

significantly by 15.8%, from 71% (October) to 82% (April) at participating schools. Control schools demonstrated a statistically insignificant increase during the same period (66% to 72%).

### Single Event Programming

The Safety Fair program, also developed by the CHMC, is another example of a school-based program. It provides several diverse injury prevention messages through a single event supplemented by additional classroom activities. The purpose is to reduce injury among elementary school children by teaching specific safety behaviors to students in kindergarten through fourth grade. The event provides hands-on activities at five separate safety stations: bicycle, pedestrian, motor vehicle occupant, home, and fire. The Safety Fair is supplemented by related classroom activities such as work sheets, videotapes, and discussions. In the evening, parents and siblings also participate and the *Safety Minutes* video is shown as an introduction to the fair.

Evaluation of the program demonstrated a significant increase in parental knowledge of safety issues 2 weeks following the Safety Fair. Students also demonstrated a significant increase in safety knowledge after the Safety Fair event but did not score significantly higher than students in control schools who had not yet attended the Safety Fair. In addition, consumer satisfaction data from students, parents, and teachers indicated that they rated the Safety Fairs as successful and useful in providing important safety information.

## Conclusions, Policy and Practice Recommendations, and Challenges for the Future

At the beginning of the chapter, we stated that childhood injury largely is a preventable occurrence and noted that young people who are socially competent should engage in fewer behaviors that are likely to lead to injury, and should be more likely to engage in safe behaviors that prevent injury. We hope that the preceding discussion adequately demonstrated these points and provided some direction for the most effective ways to intervene to prevent injury.

It is commendable that the *Healthy People 2000* goal of reducing unintentional injuries was achieved in 1993 (DHHS, 1995). The challenge is to maintain that accomplishment. For instance, many states are increasing highway speed limits, so there is risk that crashes may become more serious. In addition, there is a need to use the knowledge we have gained to decrease injuries even further, such as by increasing the use of helmets by motor cyclists, decreasing the availability of firearms, teaching conflict resolution skills, and eliminating violence in the media.

Clearly, a number of policy implications can be derived from this discussion. Although educational and environmental strategies can affect the number of injuries sustained, these efforts will be improved substantially if supporting legislation is enacted and enforced. As suggested, the strategies used to pass CSS legislation appear applicable to other areas such as bicycle safety helmets (for which use is estimated to be 5% to 10%; DHHS, 1995) and installation of thermostatically controlled safety valves to regulate the temperature of the hot water flowing into bathtubs. Of course, such efforts should be part of a comprehensive injury prevention campaign. Needed also is more surveillance on injury morbidity and mortality to identify the causes and outcomes of injuries, as well as to evaluate the effectiveness of prevention programs. At this time, for instance, there are no national data on injury prevention instruction occurring in schools (DHHS, 1995), and little is known about its cost-effectiveness. Knowledge of protective mechanisms likewise is limited. Because of the scope of the problem and the need for coordinated efforts, the federal government should provide the leadership and funding to support such efforts.

In the absence of state or national legislation, it seems reasonable on the local level for schools or park boards to require those who ride their bikes or use roller blades to wear safety equipment. Other safety rules are adopted routinely by schools and other organizations serving youth. Local governments, community organizations, and schools could become partners in many of these injury prevention efforts. In addition, if the federal government continues to resist enacting legislation about handgun design to protect children, states must do so.

Promotion of social competence skills, similar to drug or AIDS education, also could be mandated by state departments of education. The incidence of interpersonal violence in schools is growing,

and unless efforts to prevent its occurrence are undertaken, it is likely to escalate further. Social competence promotion programs also could include a focus on unintentional injury, similar to other areas of focus such as smoking, pregnancy, and child abuse prevention; there is overlap in the mechanisms that lead to these various problem behaviors. Parents and other community members must be involved in these efforts so that focused alliances of stakeholders can be formed. In addition, despite technological solutions to many of the problems, we must not lose sight of the role of personal and social values, behavior, and responsibility in the origin of the problems and in their solutions.

Coalitions of child care providers are also needed. Pediatricians increasingly are routinely including safety issues in their interactions with children and families (DHHS, 1995). Psychologists must continue to develop applications that are relevant to public health so that their ideas are incorporated into the public health infrastructure that provides much leadership for many injury prevention endeavors (Leviton, 1996). Those in other professions also have contributions to make. Ultimate success depends on using the contributions and perspectives of many disciplines and stakeholders.

The challenge to prevent injuries is clear. The question is not whether we, as a nation, must take up the challenge but rather who will do it and how it will be accomplished so that our communities—including children and families—are safe and healthy.

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